Center Innovation Fund: GSFC CIF

Ultra-Stable Kinetic Inductance Detectors for Astrophysical Observations

Completed Technology Project (2017 - 2018)

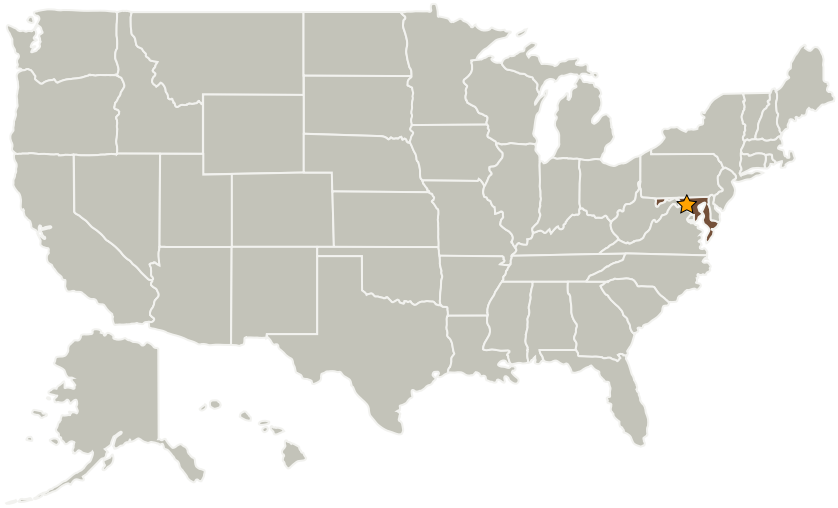
Project Introduction

This proposal seeks to implement a new KID design to reduce the low-frequency 1/f noise limiting the performance of this detector technology. This innovative design is based on work demonstrating near theoretically achievable current density in superconducting Nb nano-wires To reduce the 1/f noise, the inductive element in the resonator will be fabricated as a mesh. The proposed tasks involve fabrication of nano-mesh inductors out of Nb, TiN, and Al. The nano-meshes will be elements of superconducting resonators enabling characterization of the DC critical current and microwave response. The detailed microwave properties of the resonators, including quality factor, Q, and noise, will be characterized using existing instrumentation.

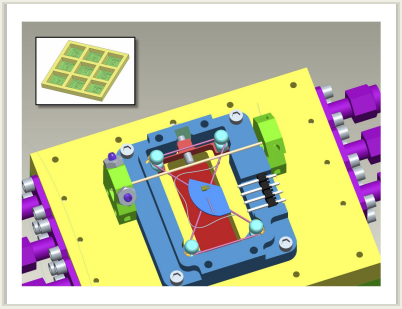
Anticipated Benefits

This effort represents fundamantal research into KIDs, which are a type of sensor that has significant potential for future astrophysical applications.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland



Microwave Kinetic Inductance Detector (KID) array (top insert) with illuminated by thermal test source.

Table of Contents

Center Innovation Fund: GSFC CIF

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Primary U.S. Work Locations

Maryland

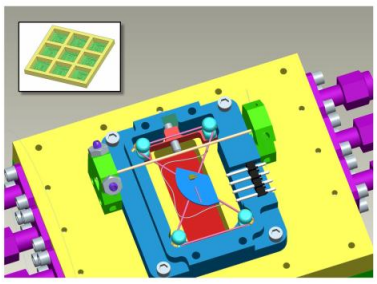
Project Transitions

October 2017: Project Start

September 2018: Closed out

Closeout Summary: Superconducting Kinetic Inductance Detectors (KIDs) offe r excellent potential for making astrophysical observations in the far infrared. Th ey are unique in terms of their fabrication simplicity. Multiplexing is achievable o n a single readout line and they are relatively insensitive to the ionizing radiatio n from cosmic rays. For this CIF, execution of this design concept required the d evelopment and analytical validation of new electromagnetic-simulation techniqu es to span the numerical dynamic range of physical interest within practical com puting resources. Meeting these needs required the extension of the supercondu cting modeling concepts for planar structures reported by U-Yen et al. (2018) th rough the use of the mean field approximation to describe the mesh surface imp edance within the resources available for finite element simulation. On the fabric ation side, the processes to realize the desired nano-mesh structures within exis ting micro-fabrications techniques were developed and characterized. Represent ative sensor structures employing these concepts developed under this effort ar e currently underway as an element of a shared fabrication run.

Images



Kinetic Inductance Detector (KID)
Microwave Kinetic Inductance Detector (KID) array (top insert) with illuminated by thermal test source.
(https://techport.nasa.gov/image/28242)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Center / Facility:
Goddard Space Flight Center (GSFC)

Responsible Program:
Center Innovation Fund: GSFC CIF

Project Management

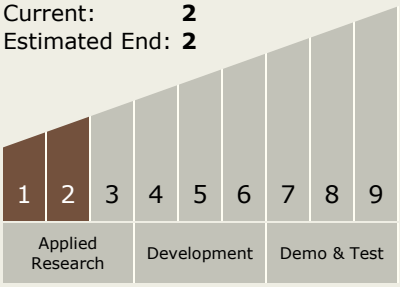
Program Director:
Michael R Lapointe

Program Manager:
Peter M Hughes

Principal Investigator:
Edward A Wollack

Technology Maturity (TRL)

Start: **1**
Current: **2**
Estimated End: **2**



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Project Website:

https://www.nasa.gov/directorates/spacetech/innovation_fund/index.html#.VC

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System

Supported Mission Type

Planned Mission (Pull)